Abstract

Catheters for treating body fluids, particularly blood, include one or more tubes through which a working fluid is circulated. The fluid characteristics, e.g., temperature or drug content, interact with the body fluid by transfer through the tube walls. For enhancing the efficiency of such transfer, energy is added to the body fluid where it contacts the tube outer surfaces for reducing the thickness of thermal and concentration boundary layers at the tube surfaces. The energy adding is accomplished by causing pulsations in the walls of the tubes, or in the dimensions of a balloon parallel to the tubes, by means of pressure pulsations in the fluids circulated through the tubes and/or the balloon. Systems are disclosed for providing and controlling the circulation of various fluids and drugs through the catheter.